

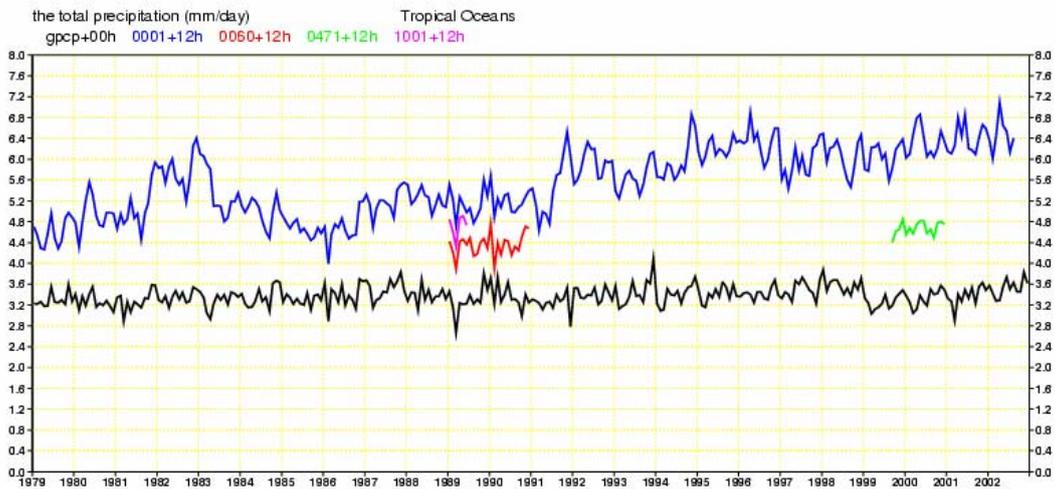
The hydrological cycle in the pre-Interim tests

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In preparation for the ERA-Interim data assimilation several short experiments have been run, using different sub-versions of IFS Cy30r1. Most of them were done with the resolution T255/N128/L60 (0471 was T159/N80/L60) and the ERA-40 observations were used.

The ERA-40 reanalysis is well known to overestimate the tropical tropospheric humidity and precipitation. The diagram below compares the estimated monthly mean rain amount from ERA40 with three experiments and with the GPCP estimates. Judging from those tests the increasing trend in ERA40 has disappeared. Experiments 0060 and 1001 (red and magenta) are different - the probable reason was most likely that 0060 used many more SSM/I data for the rain assimilation.



The ERA40 precipitation was also affected by spin-up, i.e. the precipitation increased during the first 24 hours of short forecasts. The spin-up is much reduced in exp. 0060 and almost eliminated in exp. 1001 (units: mm/day)

Assimilation	+06h	+12h	+24h	+36h
ERA40	2.99	3.07	3.25	3.17
0060	-	2.89	2.98	2.99
1001	-	3.03	3.06	3.05
198901-198906				

Likewise, the global balance between precipitation and evaporation “P-E” is much improved in the pre-Interim tests as seen in the table below.

Assimilation	+06h	+12h	+24h	+36h
ERA40	0.15	0.21	0.34	0.24
0060	-	0.01	0.10	0.10

The many revisions – not the least to the humidity analysis and the cloud/radiation parametrization has also lead to substantial changes in the energy balances at the top and bottom of the atmosphere. Experiment 0060 is compared with ERA-40 for the same two years and the 23-year ERA-40 climate in the table below. The cloud forcing is the effect of the clouds on the radiative energy loss from the surface. The difference in cloud forcing between ERA-40 and the 0060 experiment is large, ~ 11 W/m², showing the sensitivity to clouds in the atmospheric energy balance.

W/m²	0060	ERA40	ERA40 23 year climate
top of atmosphere	-1.9	-7.4	-7.4
cloud forcing	-23.3	-34.9	-35.7
surface land	+1.8	+1.8	+1.6
surface sea	+11.3	+5.8	+4.2
all surface	+8.6	+4.6	+3.5

A short summary of the improvements seen in the pre-Interim tests (for 1080-1990) follows.

- the precipitation is more realistic (according to GPCP) both in the tropics and at mid-latitudes
- no temporal trend in the total column water vapour nor in the precipitation
- no precipitation spin-up in the most recent test experiment (1001)
- global P-E in good balance (perfect in 0060+12h)
- less cirrus, especially in the tropics
- more stratus over the eastern flanks of the subtropical oceans (‘upwelling’)
- top-of-atmosphere energy exchange better (0060 -2 W/m², ERA40 -7 W/m²)
- Saharan soil is drier and warmer in 0060
- surface energy exchange worse (0060 +9 W/m², ERA40 +4 W/m²).